

## Four-Strand High Tension Median Cable Barrier Analysis

The Massachusetts Department of Transportation (MassDOT) has performed a safety evaluation of four-strand high tension median cable barriers installed in previously open medians along 21 segments on 9 sections totaling 33 miles of limited-access urban and suburban freeways and expressways throughout the state, with the intention of developing a Crash Modification Factor (CMF) for the treatment and performing an economic analysis to assess the treatment's viability. A CMF is a factor indicating the anticipated change in crash frequency of a given crash type with the installation of a treatment. A CMF of 0.28 was calculated for cross-median crashes, meaning there is estimated to be a 72% reduction in those crashes due to the installation of median cable barrier. **Further, evaluation results estimate that a \$1 million investment in a median cable barrier system is estimated to prevent 3 fatal/incapacitating injury cross-median crashes along with 7 non-incapacitating/possible injury cross-median crashes over 20 years.**



Figure 1 – A portion of median cable barrier along I-495, south of Exit 3 in Middleborough

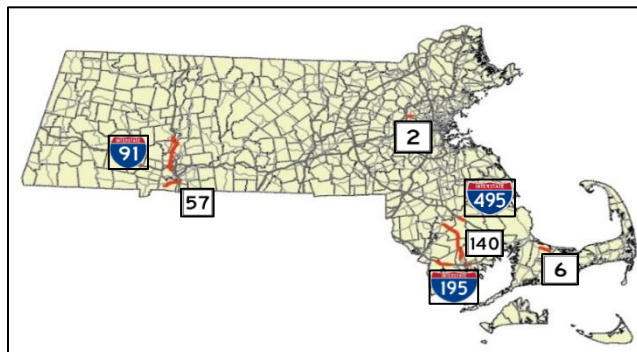


Figure 2 - Map indicating locations of median cable barrier study sites (highlighted in red)

## Background

MassDOT has identified cross-median crashes as an issue on its divided highways and has chosen to utilize median cable barrier systems to reduce and/or eliminate these crashes. Although they are a low percentage of overall crashes on these facilities, cross-median crashes have been targeted due to their tendency to be high severity, with 21% of them resulting in a fatality or major injury and a further 45% resulting in a moderate or minor injury. In 2006, MassDOT installed a run of median cable barrier on I-

495 in Middleborough between Exits 2 and 3 due to a high frequency of serious cross-median crashes. Due to the treatment's effectiveness at reducing cross-median crashes, cable barrier was installed in medians throughout the state.

The Federal Highway Administration considers median cable barriers an ideal option for retroactively protecting an existing open median due to the system's relatively low installation and maintenance costs compared to more pricy steel or concrete barriers. When struck by an encroaching vehicle, cable barrier systems mitigate median crossings by deflecting laterally, absorbing energy and reducing the impact on vehicle occupants.

Previous research in other states has shown these systems to reduce cross-median crashes by over 90% ( $CMF < 0.10$ ). The purpose of this evaluation is to measure the effectiveness of these barriers on divided freeways in Massachusetts. Four-Strand High Tension cable barriers have been installed within the median on various divided highways throughout the commonwealth. For this analysis, 21 segments from 9 non-interchange treatment sites have been identified.

## Results

The effect of the median cable barrier on cross-median crashes was evaluated using an Empirical-Bayes Before/After with Comparison group methodology. The analysis indicated that the treatment results in a 72% reduction in cross-median crashes on divided freeway non-interchange segments. This means the treatment has a CMF of 0.28 with a standard error of 0.11. It is estimated that over the 20-year lifetime of the treatment sites the median cable barrier will prevent 3 fatal cross-median crashes on the treated sites, along with an additional 20 cross-median crashes resulting in an incapacitating injury.

The reduction in cross-median crashes, though somewhat offset by an increase in property-damage only (PDO) crashes due to reported barrier strikes (which are likely previously unreported roadway departures), results in a benefit-to-cost ratio of 5.23 to 1<sup>1</sup> for the treated sites, given a 20 year lifespan for the system, meaning that for every \$1 spent on median cable barrier, the department should expect a return of \$5.23. The increase in PDO run-off road left crashes leads to increased maintenance costs for the system as well as decreased societal benefits due to the costs of the crashes. These results are consistent with findings of other states, including Nebraska, Washington, and Texas, when adjusting for differences in construction and maintenance costs due to the relatively low mileage installed in Massachusetts.

## Discussion

The resulting CMF of 0.28 shows less reduction than has been found in other states. This is due to the observation of 7 cross-median crashes in the "after" treatment period. In these crash events, the vehicles were able to cross the median, despite the installation of the cable barrier, for reasons such as vehicles vaulting the barrier (2), tractor-trailers overriding the barrier (1), vehicles passing through breaks in the barrier for emergency vehicle access (1), and general failures of the system to contain the vehicle (3). These crashes should be taken into consideration when designing further median cable barrier installments.

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<sup>1</sup> This memorandum has been updated to reflect newly adjusted comprehensive crash costs from FHWA for the state of Massachusetts.